

Monetary Policy and Currency Wars: Methodological Approach

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Introduction. The theme of our investigation is topical because of some up-to-date processes in the world economy. After 2008 world economic and financial crisis many aspects of macroeconomic management have been changed drastically. Some countries now use different monetary, economic, and political instruments in order to stimulate growth of their national economies. It is necessary to focus your attention on the fact that since that crisis the role of the central banks has become more significant. Most of them have changed their monetary policy principles and now they use some different monetary instruments. As a result of quantitative easing implemented by some developed countries such as, for example, the USA and Japan, or foreign exchange interventions by the central bank of Switzerland, in order to devalue their national currencies, some developing countries began suffering from competitiveness losses of their national products. The term "currency war" was used by Brazil's Finance Minister Guido Mantega in September 2010. He meant an aggressive monetary policy that aimed competitive devaluation, but this economic phenomenon is not new.

The topic of our investigation is concerned about currency wars. The most laconic definition of currency war we have met is "deliberate policy of manipulating exchange rates downwards to increase domestic competitiveness" by Jon Danielsson (2013) should be added with "that take place in many countries at the same time and lead to some international damage". There are enough publications about currency wars. First of all, it is necessary to mention James Rickards' book. He is known to be an expert in this issue. We have found 36 related publications in Scopus database, especially in the journal "Review of International Political Economy". But the most publications are papers in news articles in the Internet. The term "currency war" is not new. The following word combinations: currency war, weak

currency policy, competitive devaluation, beggar-thy-neighbor policy – have the same connotation. In our research we used papers by Chinn (2006); Ali, Anwar (2001); Eichengreen (2013); Peters (2014); Durusoy, Beyhan (2015); Moschella (2015). But we found not many articles where currency war monetary policy was analyzed from the transmission mechanism point of view.

What instruments can be used to manipulate exchange rates in the modern international monetary system? It depends on the exchange rate arrangement announced by a country. Theoretically, in case of free float the government doesn't interfere in the market mechanism of exchange rate, and usually do influence exchange rate with the help of interest rates and quantity of money. In case of managed float exchange rate system regulators often use official reserves to make interventions and instruments such as capital control and other restrictions. Use of interest rates and quantitative easing by developing countries might have negative effect on the economy. And we reckon that it is mainly connected with expectations. Practically, today the most usable instrument is interest rates.

The aim of the “currency war” policy is to gain some positive effect for the national exporters. However, that policy influences not only the exporters but the whole economy. So, we decided to use the real effective exchange rate index as a result index in our investigation. Real effective exchange rate is the weighted average of country's currency relative to an index or basket of other major currencies adjusted for the effect of inflation. This index reflects nominal exchange rate, price indices for a country and its trade partners, and some information about trade activity and its perspectives. Therefore, this index reflects not only the first response on the monetary authorities' action that is connected with nominal exchange rate change, but with such responses as inflation, net export, and, finally, the structure of trade partners. This index was used as an index of country's competitiveness by such authors as Calvo, Leiderman, and Reinhart (1993); Bandara (1995); Edwards (1998); Agenor (1998); Lartey (2008); Combes, Kinda, and Plane (2011). Mainly, they regard it as an indicator of changes of current account and capital flows that can lead to financial instability. Index rise means currency depreciation, but index fall reflects appreciation of it.

How can the monetary authorities influence some economic processes? In theory, there are many transmission mechanism channels. They are the ways of influence central bank's monetary policy on a final index. In practice, not all of them are the real working channels in a particular case, for a country which is characterized by its level of economic development,

and financial markets development, central bank's monetary instruments available, monetary policy framework, foreign exchange rate regime, and other features. In our case, the exchange rate channel is more interesting one. For instance, a central bank can use a political interest rate, official reserves or interventions in order to change monetary base or monetary aggregates (national money supply); it causes alteration of a nominal exchange rate; then it leads to changing in import supply and export activity that is reflected new statement of current account balance and capital flows. All the links of the chain lead to a new output and new prices in the economy. We are not going to look at the output but we speak about an international countries' competitiveness that connected with its possibility to gain from a central bank's monetary policy. So, our result index is the real effective exchange rate index.

Objectives of our investigation are as follows:

- to determine effect of using different instruments of monetary policy by some countries;
- to assess the results of implementing currency war methods which can increase their national competitiveness for different countries;
- to supplement results getting with different methods of investigation.

First of all we tried to determine the key instruments of monetary policy that are used by some countries which are characterized by different levels of economic development and different inner monetary policy frameworks and exchange rate arrangements. Then we thought about methodological aspects of our investigation and made some assessments of implementing currency war methods by the central banks. We did it with the help of different math approaches which can supplement each other results.

Methodology. The key point of our investigation is offering a methodological approach to assessment influence of currency war monetary policy on the economic development that in our case is connected with international trading first of all. The scheme of our research is briefly shown on the Fig. 1.

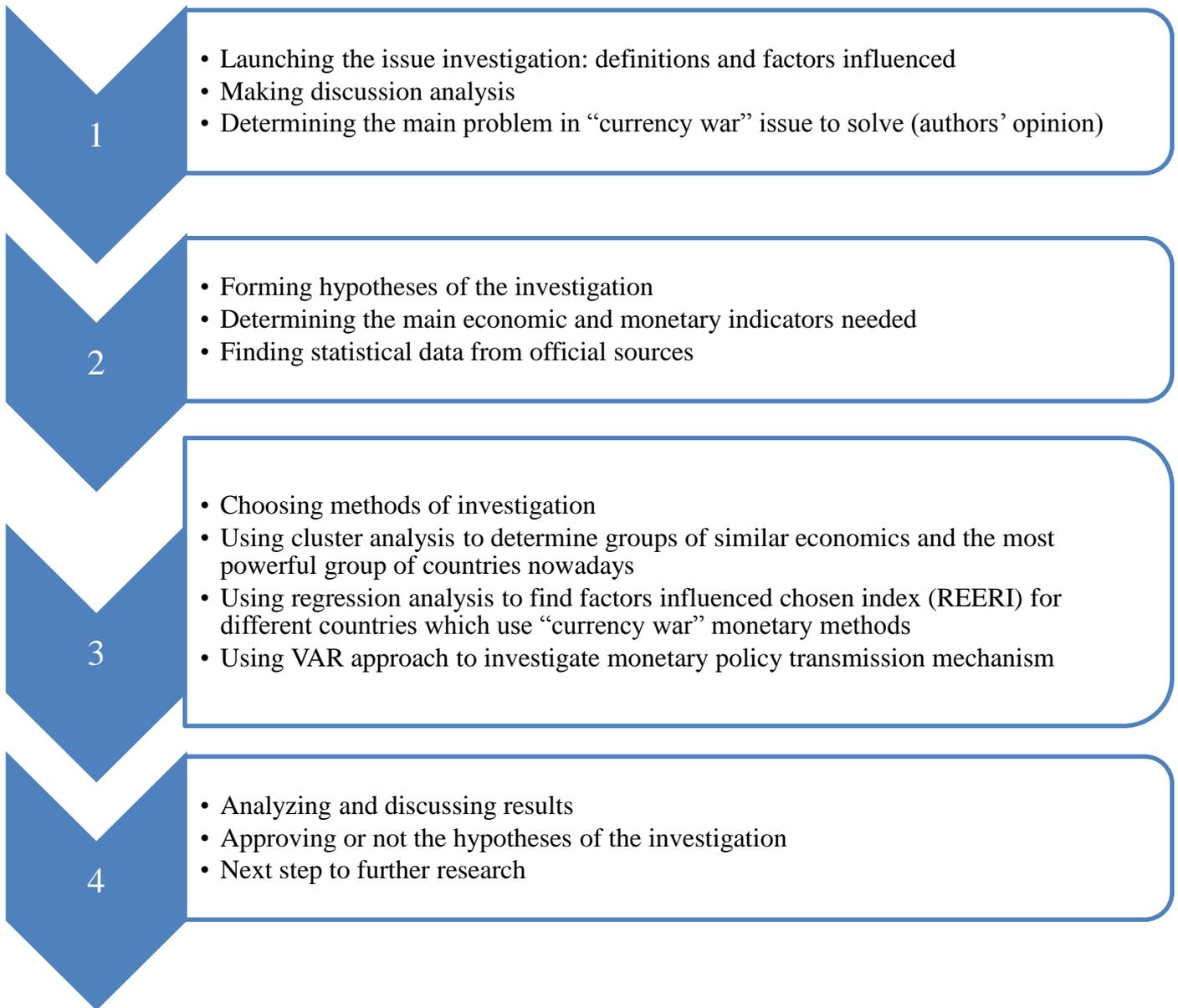


Fig. 1. Methodology: Plan of the Research

The first step in the scheme is described in the introduction of this article. The main problem to solve is to determine key differences in monetary policy results for developed and developing countries, as well as countries with different types of foreign exchange arrangements and monetary policy frameworks which would participate in currency wars. Real effective exchange rate index was used as the key index for our analysis.

The second step is about making hypotheses and getting statistics. The hypotheses of our analysis are as follows. There are some positive effects of monetary policy on country’s competitiveness in developed countries as well as in developing ones, in countries with different exchange rate regimes and different frameworks of monetary regimes. The effect of monetary policy on country’s competitiveness can be obtained through different channels of

monetary transmission mechanism. It depends on exchange rate regime and control on the foreign exchange market.

We applied eight indices connected with foreign exchange markets and monetary policy for 50 countries for the cluster analysis, four ones for the regression analysis, and eight indices for the VAR analysis. Some of these countries are economically developed; some of them are the countries with emerging markets. They are characterized by different exchange rate regimes and their monetary policy targets. The indices are as follows: GDP, REERI, CPI, Official exchange rates (per SDR), Deposit interest rates, Export, Import, Money (M2), Gold reserves, Official reserves (total minus gold); MB, Interbank rate, Current account balance, Direct foreign investments, Credits by domestic banks, Domestic consumption. The main statistical sources are the International Monetary Fund database, the Federal Reserve Bank of St. Louis statistics, and central banks' web-sites. The period for analyses is 1994 – 2015.

The third step of the methodology scheme is choosing method of the investigation. The results are going to be compared and supplemented each other. Cluster and regression analyses were used as the methods of investigation to determine groups of similar economies and the most powerful group of countries nowadays and find factors influenced chosen index (REERI) for different types of economies. Implementing this step we will be able to find the similarities and features for different countries both for developed and developing ones.

After that we will concentrate on several countries for deeper understanding of monetary policy's role. The Vector Auto Regression approach was used for analyzing the ways of monetary policy which could influence a country's competitiveness.

The final step of the plan is about analyzing and discussing results of our investigation.

The key step of the scheme is choosing methods of the investigation. Cluster analysis as method of classification was made with the help of self-organizing Kohonen map method. The regression analysis was used in order to find factors influenced a country's competitiveness. Our investigation suggests a model of assessment of monetary policy effect on a country's competitiveness:

$$REER_t = \sum_{j=1}^k \alpha_j REER_{t-k} + \sum_{j=1}^n \beta_j e_{t-n} + \sum_{j=1}^m \gamma_j CPI_{t-m} + u_t$$

$$e = \sum_{j=1}^p \varphi_j e_{t-p}$$

$$CPI_{i_{t-m}} = (CPI_{i_t}; CPI_{i_{t-1}}; CPI_{i_{t-2}}; \dots CPI_{i_{t-m}})$$

$$CPI_{i_t} = \frac{CPI_t - CPI_{t-1}}{CPI_t} \times (r - r')$$

where:

REER – real effective exchange rate index,

e – nominal exchange rate,

$CPI_{i_{t-m}}$ – vector of CPI_{i_t} with m lags,

k, n, m, p – lag numbers for variables,

$\alpha, \beta, \gamma, \varphi$ – lag coefficients,

u_t – regression error,

CPI – consumer price index,

r – interest rates on domestic financial markets,

r' – average rate of return on financial market,

t – number of periods.

The key instrument of a modern monetary policy is a basic interest rate which is a base for other financial instrument yield, and can influence price level in economy. As an experimental (dependent) variable we chose an index that reflects country's competitiveness. Monetary regulators determine a nominal base interest rate; and its influence on the real macroeconomics indices depends on a great number of the factors. It is fair that there is mutual influence of this monetary instrument of central bank and inflation. In order to describe this influence an interactive variable was proposed. The first equation shows how nominal exchange rates, nominal interest rates and price level influence country's competitiveness taking into consideration lags of indices. So, we can conclude whether there is cyclicity in competitiveness forming and what is time length for monetary instruments influence. CPI reflects the influence both of price level and nominal interest rate and its significance would mean the monetary policy's effect on the level of country's competitiveness.

After regression analysis we applied the VAR approach to the five countries under consideration to find a way of monetary policy influence. The regression helped us to define the monetary policy effect, and then we expanded our research focusing on mechanisms of monetary influence on country's competitiveness. The VAR analysis helps find and estimate

impulse responses of some indices to a shock in monetary policy measures. So, the idea of transmission mechanism in our case is connected with the following indices (Fig. 2).

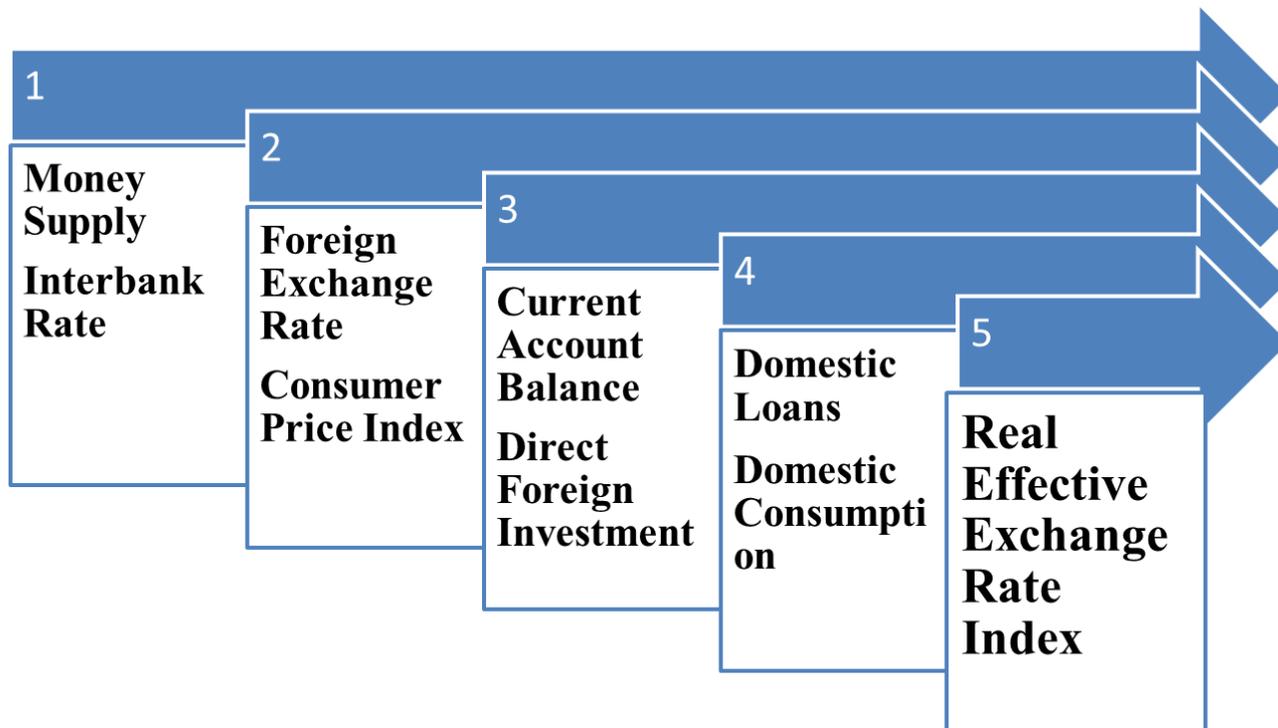


Fig.2. Methodology: VAR & Transmission Mechanism

Nowadays a central bank use monetary instruments such as percent rates, quantitative easing, open-market operations, interventions, and banking reserves. In response to implementing them, money supply and interbank rate change quickly (some authors associate these indices with monetary policy instruments). This leads to price changing for all kinds of financial instruments, foreign currencies, and goods. Then the spending capacity and business opportunity lead to changing in international trade results and capital flows. Finally, we will see a new level of country's competitiveness that is shown by the real effective exchange rate index.

We wrote the model of the VAR approach the following way:

$$\begin{aligned}
 X_t &= (CAB_t; DFI_t; DL_t; DC_t) \\
 Z_t &= (M_t; IR_t; FER_t; CPI_t) \\
 X_t &= A \times X_{t-i} + B \times Z_{t-i} \\
 REER_t &= C \times X_{t-j} + D \times Z_{t-j} + L \times REER_{t-j}
 \end{aligned}$$

where

A, B, C, D – coefficient matrixes

$i = 1, \dots, n$

$j = 1, \dots, n$

The main equation shows dependence of the competitiveness index from other variables and their lags. All the variables are from the Fig. 2. In order to solve a stationarity problem we used changes. Dickey-Fuller test was made to test if the data are not trending; likelihood maximization method was used to determine lags and the size of lagged variables. In order to estimate impulse response firstly we generated 5 month impulse response function; if an index didn't return to its balance during this time, we generated 12 month one.

Results and discussion. Table 1 shows the list of countries which were mentioned in the news as those participated in a modern currency war. For example, Switzerland pegged its exchange rate maximum to euro in 2011 and gave up in January 2015. China uses interventions to maintain its currency undervalued. Japan and other developed countries help their economies with low interest rates and quantitative easing. All of them are characterized by their exchange rate arrangements and monetary policy frameworks. This classification is proposed by the IMF (in fact, there are more exchange rate and monetary policy regimes).

Table 1. Countries involved in currency wars since 2010

Exchange Rate Arrangement	Monetary Policy Framework					
	Exchange rate anchor (US dollar)	Exchange rate anchor (euro)	Exchange rate anchor (composite)	Monetary aggregate target	Inflation targeting framework	Various indicators or EMU
Stabilized arrangement		Denmark	Singapore, Vietnam			
Conventional peg	Venezuela					
Crawl-like arrangement				China		Switzerland
Floating					Brazil, South Korea, Thailand, Turkey, Indonesia, Peru, Poland	
Free floating					Australia, Canada, Japan, Norway, Sweden, the UK	The USA, Germany, France

Sources: the Internet sources review. Exchange Rate Arrangements and Monetary Policy Frameworks (IMF, 2014)

Cluster analysis was made with the help of self-organizing Kohonen map (network) method for 2012 (Fig. 3). It was drawn up for 50 countries to find some common and different characteristics of them in terms of key macroeconomic monetary indicators, foreign exchange market indicators, possibility of use official reserves and their structure. This map contains 13 clusters but some of them consist of the only country, so they could be unnecessary or particular. Here we can mention a kind of homogeneity inside clusters. There are joining in the same clusters, for example, 1) Brazil, Russia, and South Africa, 2) Belgium, Netherlands, Australia, Canada, and New Zealand, 3) some other advanced economies, 4) some leaders of a modern world such as the US, the UK, Germany, France, Italy, and China. These clusters are not the similar to the ones of the classification in the Table 1.

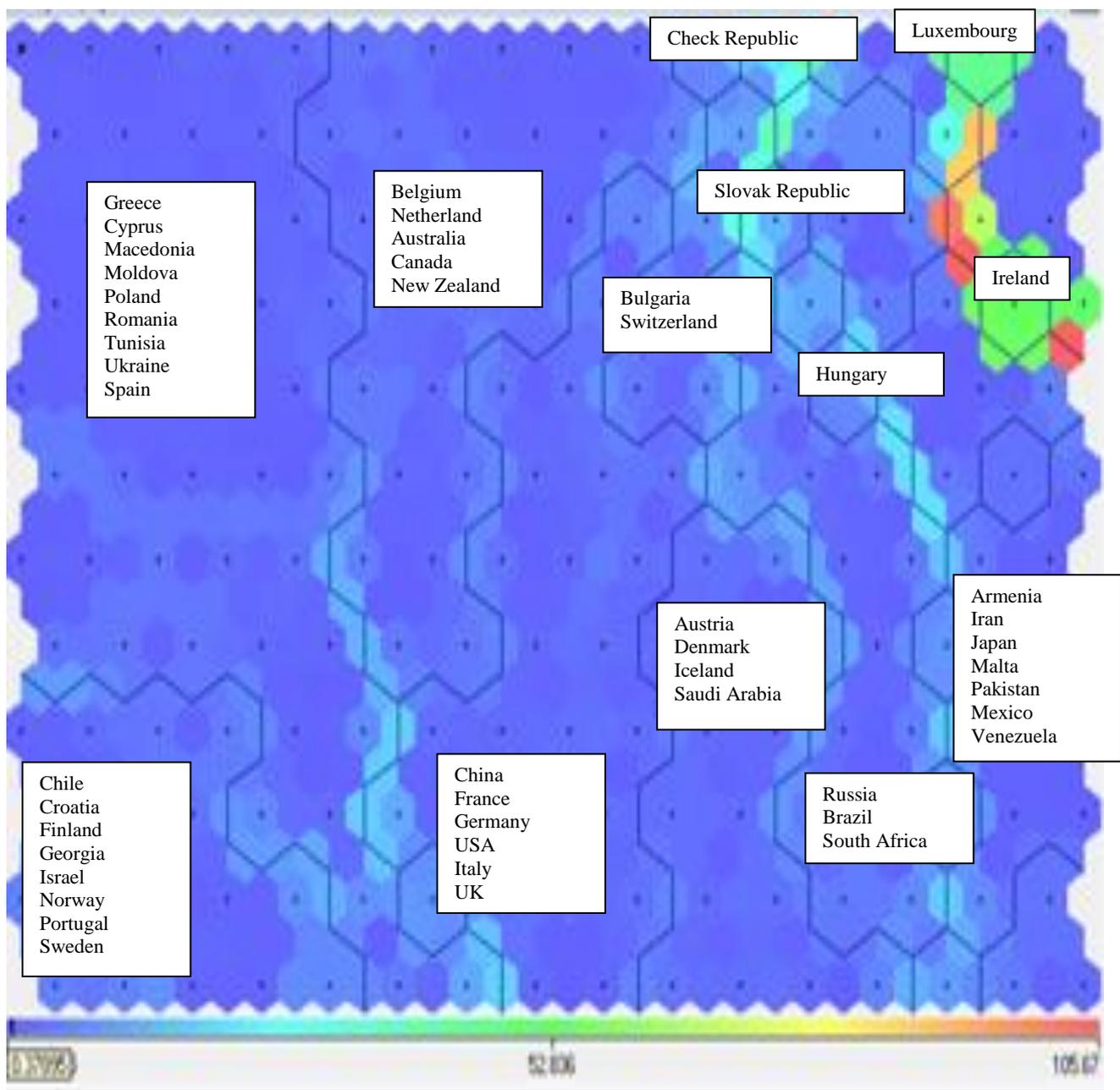


Fig. 3. Cluster Analysis: 2012

We use the indices in Table 2 to make the map.

Table 2. Cluster Analysis: 2012. Mean values for clusters

Cluster	GDP, % of the world	Gold, % of the world	Official reserves, % of the world	Money increase (%)	REERI (2005 - 100%)	CPI (2005 - 100%)	Interest rate	Export, % of GDP
1	0.08	0.07	0.01%	-2.45	100.4	118.4	0.64	193.37
2	0.30	0.02	0.01%	-0.44	95.6	112.0	2.90	105.64
3	0.13	0.10	0.01%	6.75	133.2	124.0	2.09	91.80
4	0.17	0.01	0.39%	-4.63	103.7	142.4	5.29	87.41
5	1.31	0.58	0.30%	2.40	107.5	117.5	2.43	48.99
6	0.28	0.04	0.39%	4.79	121.3	121.1	1.02	76.52
7	0.49	1.70	1.85%	14.45	118.1	125.7	1.55	65.82
8	0.50	0.53	1.66%	4.08	92.3	134.3	1.76	54.67
9	0.40	0.22	0.19%	39.45	104.5	141.0	5.71	42.38
10	0.34	0.23	0.28%	2.32	106.3	236.8	3.83	39.37
11	8.00	9.34	5.45%	5.34	98.9	117.8	1.63	28.50
12	2.17	1.21	2.63%	8.55	122.5	160.5	6.29	23.76
13	1.61	0.60	1.77%	16.06	124.4	212.4	7.20	15.78

Cluster 11 includes the leaders. These six countries have the biggest mean values of GDP, official gold reserves, and official foreign currency reserves. Their real effective exchange rates are stable. Inflation and interest rates are almost at the bottom among the extract. It is interesting that four of them emit widely used reserve currencies; the UK pound becomes more usable and Chinese yuan does as well. All their national currencies are used as basket components to calculate the SDR.

Our further analysis concentrates on five countries from different clusters, levels of economic development, exchange rate arrangements, and monetary policy frameworks. They are the followings: Brazil, China, Japan, Switzerland, and the UK. Where are they? Brazil is situated in the cluster 12, Japan is in 13, Switzerland is in 7, and China and the UK are in 11. But the two latter are the countries of different economic development levels.

To make a regression we used four indices such as real exchange effective rate, consumer price, interest rate, and nominal exchange rate per US dollar for 5 countries for 21-year period monthly. There were 255 observations for each of them. First of all, two interesting results. The first one, we didn't find any significant variables in case of China. The reason might be a particular kind of monetary regulation, strict control on financial markets, and using instruments for it; but our model reflects market mechanisms. The second one, we determined that the lag of one month is correspondent to all the variables in our investigation. It means that the response to monetary instruments used is very fast. The same conclusion we have met in different papers (for instance, Dornbush, 2008).

Regression comparison is in the Tables 3 – 6.

Table 3. Regression for Brazil

	Coeff.	Z-value	P>z
REER	0.987	9.87	0
e	0.001	0.62	0.537
CPI_i	6.55	1.83	0.067
Const.	0.37	0.39	0.695

Table 4. Regression for Japan

	Coeff.	Z-value	P>z
REER	0.9887	92.08	0
e	0.02216	1.83	0.067
CPI_i	-31.33	-1.53	0.126
Const.	0.77	0.99	0.895

Table 5. Regression for the UK

	Coeff.	Z-value	P>z
REER	0.995	109.38	0
e	3.8688	1.93	0.054
CPI_i	0.259	0.01	0.993
Const.	-1.79	-0.97	0.334

Table 6. Regression for Switzerland

	Coeff.	Z-value	P>z
REER	0.96887	50.78	0
e	-0.2662	-0.58	0.563
CPI_i	-3.909	-0.14	0.883
Const.	2.79	0.87	0.352

For all countries under consideration the competitiveness level is explained by its value of the previous period by one per cent approximately. In Brazil the monetary policy and inner macroeconomic factors, such as interest rates and price level, are effective because of an interactive variable is significant in the regression, but in Japan the nominal exchange rate is significant. So, this part of our investigation shows that we can make a suggestion that now such kind of monetary instruments as percent rate can be effective for international country's competitiveness in case of developing countries which don't use strict control on financial markets.

Using the VAR approach we tried to estimate impulse responses of the real effective exchange rate index to different shocks. For the countries under consideration we found significant variables and their lags, and then generated impulse response functions. What about results? And, again, we didn't find any significant variables for China. The variable that can influence the competitiveness level for the UK and Japan is money supply, and it

effects with the lag of one month for the former country and two months for the latter one. The balance of current account is significant for the UK and Switzerland. For Switzerland nominal exchange rate and direct foreign investment were significant either. For Japan one more significant index is loans by domestic banking system. So, we could generate impulse response functions for them; lags for the indices were one or two months. Brazil, the only developing country we could analyse using the VAR approach, has two significant variables: percent rate index with lag of one month (Fig. 4) and nominal exchange rate index with lag of two months (Fig. 5). The effect for both of them is fast but the directions are different. The percent rate rises, the competitiveness level falls; and different way for the exchange rate index.

The impact of interest rate change that disappears in 5 months shows the immediate effect on the REER. The increase of exchange rate leads to decrease of the REER because of exchange rate parity, and then the competitiveness slowly backs to its former level. The change of interest rate also causes shock of the REER immediately; competitiveness level grows drastically and then it declines slowly to the initial level in 5 months.

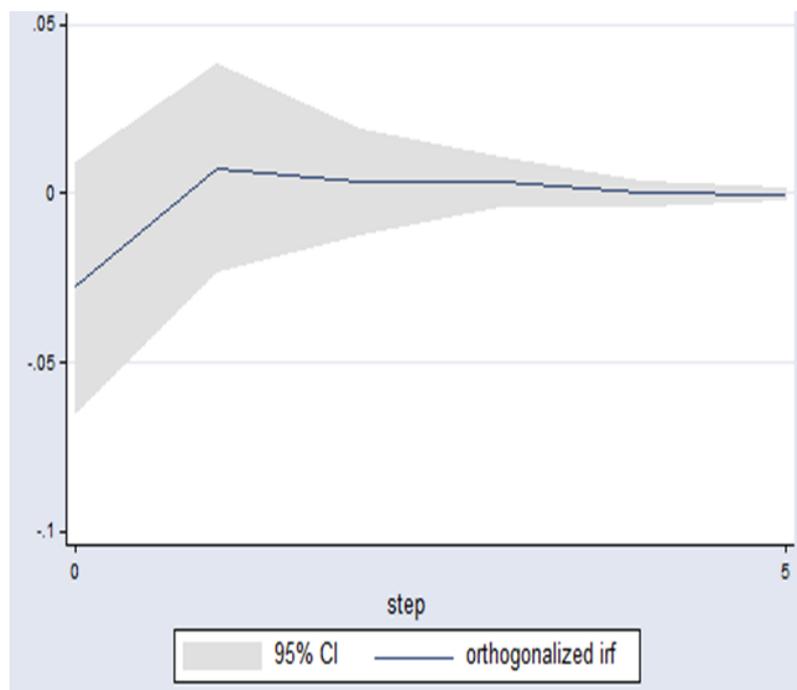


Fig. 4. VAR. Results: Brazil. Impulse response to percent rate

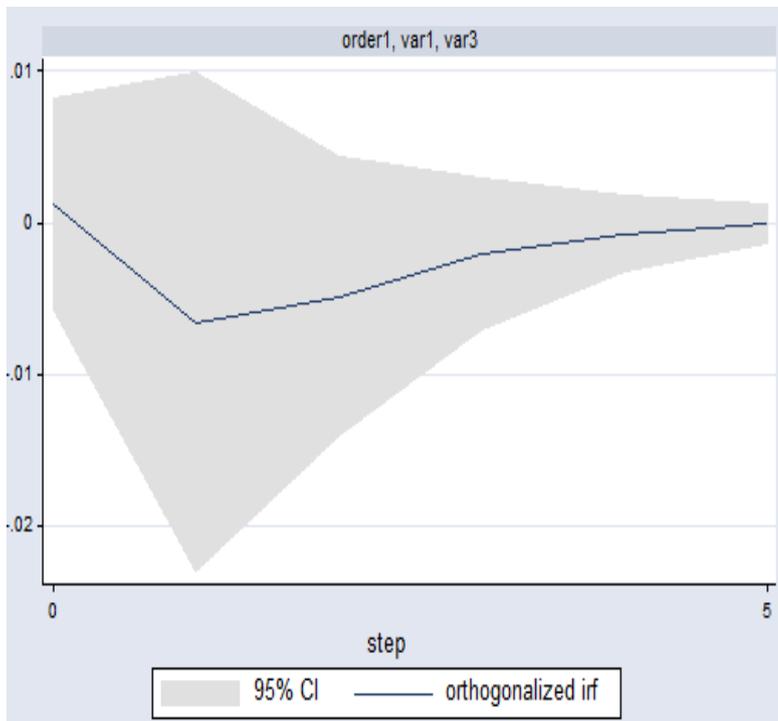


Fig. 5. VAR. Results: Brazil. Impulse response to exchange rate

The important result is that the interest rate index is not significant as monetary instrument for developed countries aiming their international competitiveness level. In fact they use quantitative measures and credit channel of transmission mechanism. Developing countries would suffer more and have strong effect from currency war monetary policy.

Conclusions.

- The main index used is the real effective exchange rate index that reflects changes of exchange rate, inflation in countries, and international trade position.
- The instruments used for analysis are cluster and regression analyses, and the VAR approach to classify countries according to monetary and foreign exchange market indices, find factors influenced the real effective exchange rates, and investigate the channels of working.
- Cluster analysis shows that the situation in the world became more definite in terms of countries' characteristics. Exchange rate regimes and monetary framework influence a country's position.
- Regression analysis shows the difference in results of monetary policy for developed and developing countries, countries with different regimes of money and foreign exchange markets.

- VAR approach shows that working monetary transmission mechanisms depend on all the country's characteristics mentioned.

Our possible further researches are as follows:

- Implement the VAR approach using other factors such as indices of open-market operations and central bank interventions.
- Concentrate on the BRICS countries, find working channels of their monetary policy.
- Make detailed analysis of the situation in the Russian Federation.